

# Research Note: In search of *Rossia pacifica diegensis* S. S. Berry, 1912

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**Abstract:** We describe the eggs of *Rossia pacifica* S. S. Berry, 1911, from a depth of 1,200 m off of southern California. The large size of the eggs and the great depth and low temperature from which they were retrieved contrasts strongly with smaller eggs of this species taken in shallower, warmer water along the western coast of the contiguous United States. This raises questions as to whether more than one taxon in the genus *Rossia* is present in this area.

**Key words:** Cephalopoda, Rossiidae, larvae, eggs, subspecies

S. S. Berry first described the sepiolid cephalopod *Rossia pacifica* from Alaskan waters in 1911. In 1912, he provided a more complete description based on specimens taken from southern Alaska to southern California. His specimens were trawled from depths of at least 30 to 310 m, possibly as deep as 550 m. In recent years, the known habitat of the species has been extended through the Bering Sea to the Tsushima Straits between Korea and southern Japan (Nesis, 1987), and southward from off of the southern California coast to about 28°N off of Baja California (F. G. Hochberg, pers. comm.); the known depth range remains approximately the same.

Considerable information now exists on the biology of *Rossia pacifica* (Brocco, 1971; Summers, 1985; Anderson, 1987, 1991; Summers and Colvin, 1989; Anderson and Vanderwerff, 1989; Anderson and Shimek 1994). Off of the northwestern coast of the continental United States, it spawns clusters of white eggs with each egg about 1 cm in diameter and ovoid in shape, except for a flattened area where the eggs are cemented to the substratum (Anderson and Shimek, 1994). The eggs have a tough outer coating and a papilla that lies opposite the flat attachment site (Anderson, 1991). Off Washington state, scuba divers have observed egg clusters attached to rocks at ocean depths of 18 to 30 m (Anderson and Shimek, 1994), and eggs have been spawned and reared in local laboratories and public aquaria (Summers, 1985; Anderson, 1991). Eggs have developed at 10°C in a temperature-controlled aquarium and from 6-12°C (monthly means) in a running seawater system that reflected ambient ocean temperatures. Under both regimes, the minimum hatching times were four and three-quarters months with spontaneous hatching

continuing for an additional two months (Summers, 1985). At hatching, the young measured 6-8 mm mantle length (ML) (Summers, 1985; Anderson, 1991). Recently, Shevtsov and Radchenko (1997) reported *R. pacifica* eggs with developing embryos from the Bering Sea at a depth of 250 m and a temperature of 1.6°C. In the northern Japan Sea, the distribution and spawning of *R. pacifica* has been discussed by Shevtsov and Mokrin (1997).

In his 1912 paper, Berry noted that specimens of *Rossia pacifica* caught off of San Diego, California, were captured at greater depths than in other localities and differed morphologically. Specifically, they (1) were smaller and more slender and delicate, (2) had relatively larger fins, and (3) carried suckers on the arms in predominantly two, rather than four, rows. Berry (1912) designated these specimens as a new subspecies, *R. p. diegensis*, while apparently feeling that the morphological differences were sufficient for specific status. His type specimens are presently deposited in the U. S. National Museum of Natural History (Washington, DC; (USNM 214376). However, as these specimens were geographically separated from other Californian specimens found in Monterey Bay, he believed intergrades might eventually be found that would negate specific status. The possible validity of this taxon has been virtually ignored since his description.

## MATERIAL AND METHODS

The material examined was collected by the R/V NEW HORIZON, 13 December 1995, with a 25 ft (7.6 m) semiballoon trawl at 33°10.25'N, 118°25.2'W (tow mid-

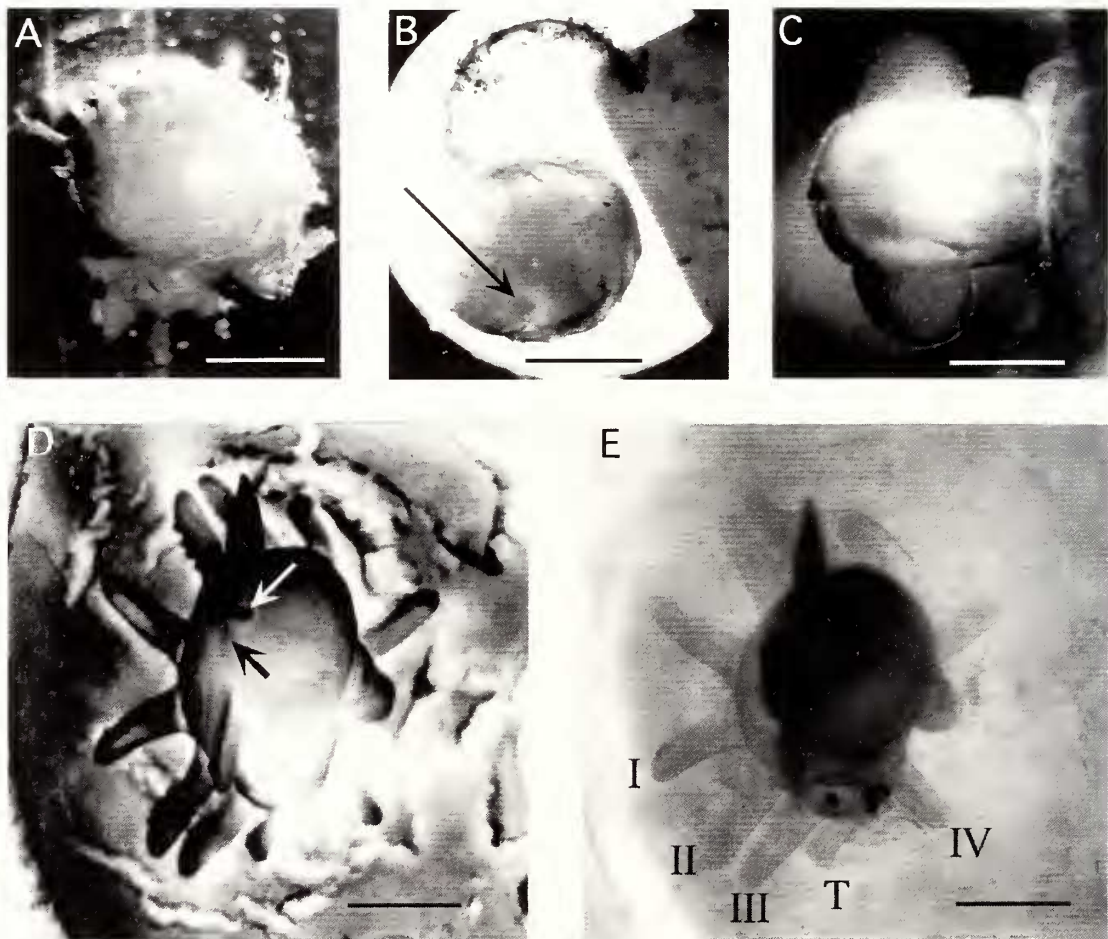
point) in the Santa Catalina Basin, California, at a depth of 1,204-1,222 m. The bottom temperature at this locality was 4.1°C. The trawl had an outer mesh of 3.8 cm (stretch) and an inner mesh of 1.3 cm (stretch). The bottom in this area is a silty clay with a disaggregated median grain size of 4.0  $\mu\text{m}$  and the benthic macrofaunal community is heavily dominated by deposit-feeding polychaetes (Kukert and Smith, 1992). The specimens are deposited in the Santa Barbara Museum of Natural History.

## RESULTS

Three large cephalopod eggs were retrieved from the trawl. Two measured 18 x 16 mm, one of which is figured (Fig. 1A). The third was 14 mm in one dimension;

damage prevented measurement in the other axis. The two larger eggs had well-developed embryos; the smaller egg had a badly malformed embryo. The surface of the egg capsules had been somewhat abraded by the trawl, preventing description other than to note that a papilla was present and that the capsule wall was about 0.5 mm thick and transparent (Fig. 1B). No obvious flat attachment site was found on the capsule.

The developing embryos appeared to be at roughly the same stage of development. One was dissected out. It has a mantle length of 2 mm at about Naef's stage XVII or XVIII (Naef, 1928) and the size of the external yolk sac, not measured due to fracturing, dwarfs the size of the embryo (Fig. 1B). Large fins arise from the sides of the mantle rather than from the dorsal side (Fig. 1C). Each fin is nearly semicircular in outline and subterminal in posi-



**Fig. 1.** *Rossia* eggs and embryos. A. Single egg in outer capsule. Photographed with reflected light. B. Single egg with embryo (arrow) and portion of outer capsule separated from egg. Distance between two lines on label paper is 1 cm. Photographed with transmitted light. C. Dorsal view of embryo showing fin shape, free dorsal mantle margin, and terminal spine. Photographed with reflected light. D. Posterior view of stained (methylene blue) embryo. White arrow indicates terminal spine; black arrow indicates hatching organ. Photographed with reflected light. E. Posterior view of unstained embryo. Photographed with reflected light. Scale bars = 1 cm (A, B), 1 mm (C, D, E). (I-IV, left arms; T = tentacle).

tion, the dorsal mantle margin is not fused with the head (Fig. 1C), and the hatching organ and terminal spine are easily seen (Figs. 1C, D). The embryo extends at right angles to the yolk sac with the arms spread laterally over the surface of the yolk (Figs. 1D, E). It has eight arms and two tentacles (Figs. 1D, E), with two rows of developing suckers on arms II and III; the armature of the other arms was not examined.

## DISCUSSION

Although the embryonic development of *Rossia pacifica* has not been described, our embryos can be identified on the following basis. They can be placed in the Decapodiformes by the presence of eight arms and two tentacles, and in Sepiolidae by the (1) stubby, blunt shape of the mantle, (2) position and shape of the fins, and (3) presence of a terminal spine (Boletzky, 1991). Within the Sepiolidae, its identity is further narrowed by the lack of a dorsal head-mantle fusion. Within the North Pacific Ocean, the only sepiolids lacking head-mantle fusion are *Rossia* and *Heteroteuthis*, but only *Rossia* is presently known from Californian waters. In addition, the small, pelagic *Heteroteuthis* hatches at less than 2 mm ML (Boletzky, 1978) and can be eliminated by the large size of our eggs. By process of elimination, therefore, the eggs belong to a species of *Rossia*.

To our knowledge, the only other record of rossian eggs from this depth is that of *Neorossia caroli* (Joubin, 1902) which was taken in a trawl at 1,234 m in the Mediterranean Sea (Villanueva, 1992). This species, known to reach depths of 1,744 m (Villanueva, 1992), could be the deepest living of all rossian species. The eggs described here are also very large for a member of Rossiinae as this group typically has eggs of 5-7 mm in diameter (Lu *et al.*, 1992). Judging from the known ratio of egg size to hatchling size in shallow-water *Rossia pacifica*, an embryo hatching from an egg of 18 mm should be more than 10 mm ML.

The only species of *Rossia* known from Californian waters is *R. pacifica*. The eggs described here differ from the *R. pacifica* eggs taken off of the northwestern coast of the continental United States in that they are much larger and were found at greater depths and at lower temperatures. Either *R. pacifica* exhibits great variability in these parameters or another *Rossia*, possibly *R. p. diegensis*, is present. On the other hand, *R. pacifica* could be a cold-water, large-egged form and the second taxon could be an unnamed warmer-water, small-egged form found at rather shallow depths along the western coast of the contiguous United States. In the latter case, *R. p. diegensis* would be invalid. We strongly urge researchers to

reexamine the possibility that a second taxon exists.

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